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Assessment of Weed Control Potentials of Butachlor in Garden Egg

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Abstract
Weed competition lessens garden egg yields. The commonest method of weed control is manual weeding which is connected with drudgery and high cost. Farmers are resorting to the use of herbicides to reduce the high cost and drudgery associated with manual weeding; but very few herbicides are labelled for eggplant production. Butachor has been useful for weed management in some vegetables like okra. The experiment was therefore set up to investigate the suitability of butachlor for weed management in garden egg. Butachlor at 1.0 and at 2.0 kg a.i./ha, were evaluated for weed control, hand weeded and weedy treatments were included as controls. Data collected were: leaves and branches number/plant, height and girth, fruits number/plant, weight of dry weeds, and yield of garden egg/plant. Butachlor at low and high concentrations was tolerated by garden egg. Butachlor used at higher rate produced eggplants with greater stem girth, number of fruits and yield/plant and had greater efficacy in controlling weeds than the ones used at 1.0 kg a.i./ha; furthermore, butachlor used at higher rate had similar performance in the number of fruits/plant it produced 84.5% fruit yields of weed-free control. Use of butachlor in eggplant at 2.0 kg a.i./ha is therefore recommended for weed control in locations with similar ecology with Asaba, Nigeria.

Keywords: Garden egg, fruit yield, herbicide evaluation, weed control

1. Introduction

The eggplant is a food that is rich in nutrients and contains vitamins, fiber, and substantial amounts of minerals. They contain other nutrients in small amounts, including niacin, copper, and magnesium (Ajmera, 2023). Eggplant produces a variety of secondary metabolites as well as other compounds such as antioxidant compounds, glycol-alkaloids, and vitamins which significantly aid good health. For example, chlorogenic acid, a very significant phenolic compound which is found in eggplant fruit skin (Prohens et al., 2013). Chlorogenic acid works as an anti-inflammatory, anti-obesity, and anti-diabetic agent and also has cardio-protective functions (Plazas et al., 2013).

Neutralizing the surplus free radicals is the role of antioxidants, to defend the cells from their toxic effects and to enhance disease prevention (Pham-Huy et al., 2008). When a free radical is destroyed by an antioxidant, the antioxidant becomes oxidized. In the body, therefore, the resources of the antioxidant are restored constantly. Consequently, an antioxidant in one particular situation is active against free radicals, while in other environments the same antioxidant may be ineffective. Also, an antioxidant, in certain circumstances, may act as a pro-oxidant, for example, it can produce toxic ROS (reactive oxygen species)/RNS (reactive nitrogen species) (Young et al. 2001).

ROS/RNS are. Cellular damage is prevented by anthocyanins, a pigment that has antioxidant characteristics that are present in eggplants (Ajmera, 2023).

Despite the nutritional and medicinal roles of eggplant in man's existence, there is insufficient supply of the fruit since eggplant production is facing a lot of problems. Obiazi (1991) has recognized pests and diseases, weed interference, post-harvest storage, and preservation difficulties as constraints militating against the productivity of crops; such problems are common with eggplant too. Climatic factors determine the outcome of agricultural production, as such, any slight undesirable changes in climate can stimulate damaging outcomes of agricultural activities (Ofuoku and Obiazi, 2021). The level of using agro-meteorological services in Nigeria is meager because of the untimely delivery of information to arable crop farmers by NIMET (Ofuoku and Obiazi, 2021).

In agricultural production, weeds are among the major causes of economic losses (Singh and Pandey, 2019). One limitation to the production of eggplant is weed interference; it competes with crops for nutrients essential to plants as well as water, allelopathic effects may be caused by weeds to crops too (Almodovar-Vega et al., 1988). In terms of allelopathic effect of weeds on eggplant, root exudates of Parthenium hysterophorus, Sorghum halepense, Echinochloa colonum, Euphorbia heterophylla, Rottboellia exaltata Amaranthus dubius, and Trianthema portulacastrum resulted in decreased the dry weight and stem length of pot-grown seedlings of aubergine when added to their growth medium (Almodovar-Vega et al., 1988). Almodovar-Vega et al. (1988) noted that root exudate solutions which were added three or four days every week brought about the reduction of seedling height. The plants that did not receive root exudates were heaviest and tallest. All the evaluated weed species triggered adverse allelopathic impact on the seedlings of eggplant through reduced plant growth (dry weight and stem length). Making the root exudates to undergo chemical analyses will reveal the allelochemcals involved.

Traditionally, the usual weed control method is the use of hoe and cutlass (Obiazi and Ojobor, 2013). Due to drudgery and time as well as the labor costs which are associated with controlling weeds manually, attempts are made at weeding frequency reduction by the inclusion of cover crops in the farming operation, and manual labor use is minimized by the use of herbicides (Obiazi and Ojobor, 2013). However, very few herbicides are known for eggplant production. In locations where labor is not readily available or very expensive, the chemical weed control method is popular (Hafez and Balah, 2012). Butachlor has been efficaciously used in okra by (Obiazi, 2022b), who noted that okra plant in plots sprayed with the herbicide had shoot biomass, okra establishment, and stem diameter similar to the ones grown in plots that received two hoe-weeding at 3 and 6 weeks growth stages. This experiment aims at assessing the weed control suitability of butachlor in eggplant production.

2. Materials and Methods

Experiment site

A pot experiment was set up to appraise the weed control suitability of butachlor in eggplant. The pot experiment was set up in Agronomy Department, Delta State University formerly in the Asaba Campus, Nigeria (long. 6^0 49^1E and lat. 6^0 14^1N.). The ecology of the place is rainforest. It has a rainy season and a dry season, the rainy season spans from April to November with first peaks in June and the second peak in September.

Eggplant Planting

Ripe eggplant fruits were purchased from Ogbogonogo market from where the seeds used for the experiment were extracted. Seeds of the eggplant were dried under shade and planted in the nursery beds on 25/02/ 2018 and raised for three weeks; and transplanted on 18/03, 2018. The study lasted for ten weeks. Sandy loam soil used for the experiment had sand of 813 g kg-1, and silt of 73 g kg-1 while 114 kg-1 soil was the proportion of clay. The soil had a pH of 5.7. Each pot was filled with sandy loam soil weighing 12 kg.

Herbicide application

A portion of 2 x 4 m was demarcated behind Agronomy Departmental building for sprayer calibration. The pots for the butachlor treatments, without the eggplant seedlings, were moved to the marked area, well positioned, sprayed with the specified butachlor herbicide concentration, and taken to a shaded area where they stayed till the following day to prevent any eventual rain from leaching the herbicide. The pots for the hand-weeded and the weedy controls were not sprayed herbicides. The treated pots in the following morning, were removed from the shaded place back to where the experiment was located.

Transplanting of seedlings

Two seedlings were transplanted to each of the twelve pots meant for the experiment; the seedlings were thinned to one seedling/pot two weeks later by retaining the more vigorous seedling.

Pest control

Pests were controlled using one ml of cypermethrin/per liter of water and applied at 3, 5, and 7 weeks after transplanting.

Application of fertilizer

Application of 3.75 g/pot of NPK 15:15:15 fertilizer was carried out by side placement when the seedlings had grown in the pots for three weeks.

Design of the **Experiment**

The design used was Completely Randomized to lay out the trial and replicated thrice. Treatments involved were: Butachlor at 1.0 and 2.0 kg a.i./ha, Weedy and Hand-weeded controls.

Data collection

Growth data evaluated were number of leaves/plant, stem girth at a height of 10 cm from soil level, and plant height. At the end of the study the following data were collected: number and garden eggs fresh weight/plant, dry weights of leaves, shoot, and root, and weed dry weight at 10 weeks after transplanting.

Data analysis

The treatment means were separated with DMRT at 5% level of probability after analysis of variance was performed on the data.

3. Results

Pre-emergence application of butachlor significantly affected several garden egg growth and yield variables, but not number of leaves/plant.

Number of leaves/plant

At the early growth stage, two WAT, treatments affected not the number of leaves/eggplant (Figure 1 a). The number of leaves ranged from 5.3 to 6.7/plant and they were similar at 2 WAT.

At four WAT, the application of butachlor significantly affected the number of leaves/plant, the butachlor-treated pots and hand-weeded pots had garden eggs plants which had 16.7 to 19.7 leaves/plant and they were similar, these figures were significantly greater than 7.3 leaves/plant in the un-weeded pots. Herbicide concentrations affected not the number of leaves/plant at this stage, the leaves were 19.7 and 17.0 /plant for pots sprayed with butachlor at lower and higher rates, respectively.

Number of leaves/eggplant at six and eight WAT followed a similar trend with that of 4 WAT growth stage; the hand-weeded and the butachlor-treated pots had 26.3 to 27.6 leaves/plant, and were similar but were significantly greater than 9.3 leaves/plant in the weedy pots at 6 WAT. In the same pattern, hand-weeded and herbicide-treated pots at eight WAT had 53.0 to 65.3 leaves/plant which were similar but significantly greater than 27.9 leaves/plant in weedy pots. At 10 WAT, 73.4 to 74.2 leaves/plant in the butachlor-treated pots were similar and were smaller than the number of leaves/plant in hand-weeded pots but significantly greater than 27.9 leaves/plant in weedy pots.

Stem height

At four WAT, stem height of garden eggplants ranged from16.6 cm in un-weeded pots to 17.4 cm in pots hand-weeded, they were similar in heights (Figure 1b).

At 6 WAT, the stem height of garden eggplants in weedy pots (38.6 cm) compared with the ones that received lower rate and the garden egg in pots hand-weeded. Plants grown in higher concentrations of butachlor were significantly taller than the eggplants in untreated pots.

A similar trend was noticed at the eight and ten WAT, plants in hand-weeded pots, and the eggplant grown in higher herbicide concentrations were similar and were taller than the eggplants in the weedy pots at the respective growth stages.

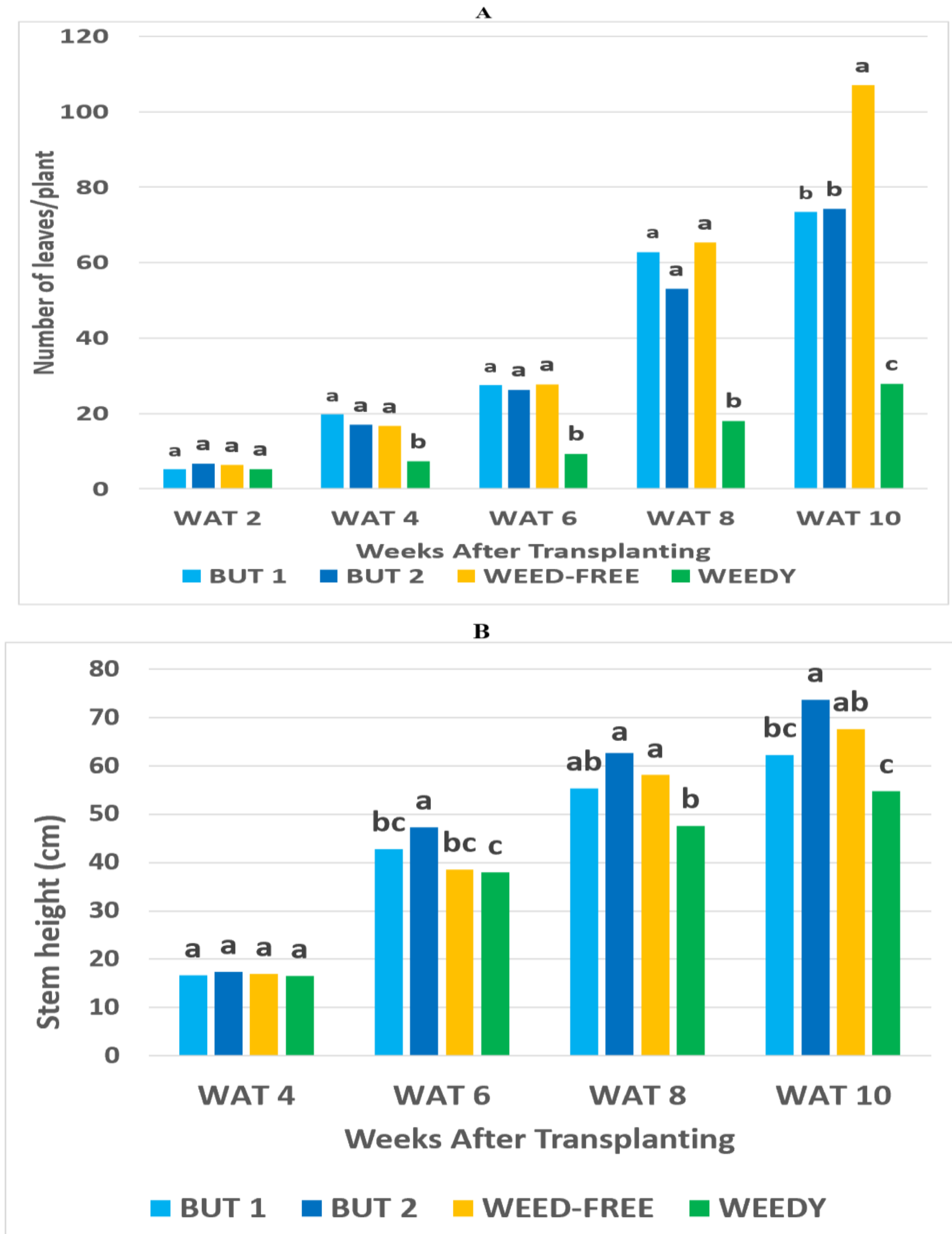


*Figure 1.0: Effects of application of two levels of butachlor on number of leaves/plant (**A**), and stem height (**B**), at ten WAT.*

Note: Bars with similar letter(s) did not differ at 5% level of probability. WAT= Weeks After Transplanting

Table 1: Effects of two levels of butachlor on stem girth, number of branches/plant, number of fruits/plant, and weed dry weight/pot

Butachlor (application rate)	**Stem girth (cm)**	**Number of branches/plant**	**Number of fruits/plant**	**Weed dry weight/pot (g)**
Butachlor (1.0 kg a.i./ha)	4.6 a	8.4 a	3.9 b	26.3 b
Butachlor (2.0 kg a.i./ha)	4.9 a	11.1 a	5.1 a	18.3 c
Hand-weeded	5.3 a	10.2 a	5.9 a	0.0 d
Weedy	4.3 a	7.6 a	1.6 c	41.3 a
SE± (0.05)	0.6429	1.5569	0.4454	2.3495

Means with similar letter(s) in a column differ not at 5% probability level using DMRT.

Butachlor 1.0 kg = Butachlor used at 1.0 kg active ingredient

Butachlor 2.0 kg = Butachlor used at 2.0 kg active ingredient

WAT = Weeks After Transplanting

Number of branches and stem girth

Branches per plant and stem girth at 10 WAT did not differ due to the method of weed control (Table 1.0). The number of branches/plant at 10 WAT were 7.6 in weedy pots and 11.1 in pre-emergence butachlor at 2.0kg a.i./ha, they were similar (Table 1.0). Stem girth which ranged from 4.3 in weedy check to 5.3 (hand-weeded pots) and were not significantly different at 10 WAT.

Weed dry weight

Weed control treatments significantly affected weed biomass per pot at 10 WAT (Table 1.0). The weedy pot had 41.3 g/pot of weed dry weight and it was the highest weed biomass, this was significantly greater than the weed biomass measured in any other treatment. Herbicide concentration significantly affected weed biomass, 2.0 kg a.i./ha rate significantly reduced the weed biomass from 26.3 to 18.3 g/pot, a reduction of 30.4 % relative to the ones sprayed lower herbicide rate.

Number of garden egg fruits per plant

The treatments made the number of fruits/plant to significantly differ (table 1.0). The highest number of fruits/plant, 5.9, was in plants grown in pots hand-weeded and was similar to the ones sprayed with the higher concentration of butachlor, but these were greater than the number obtained in lower concentration of butachlor. As low as the yield from the lower herbicide treatment was (3.9), it was still significantly greater than the 1.6 fruits that was produced by un-weeded plots.

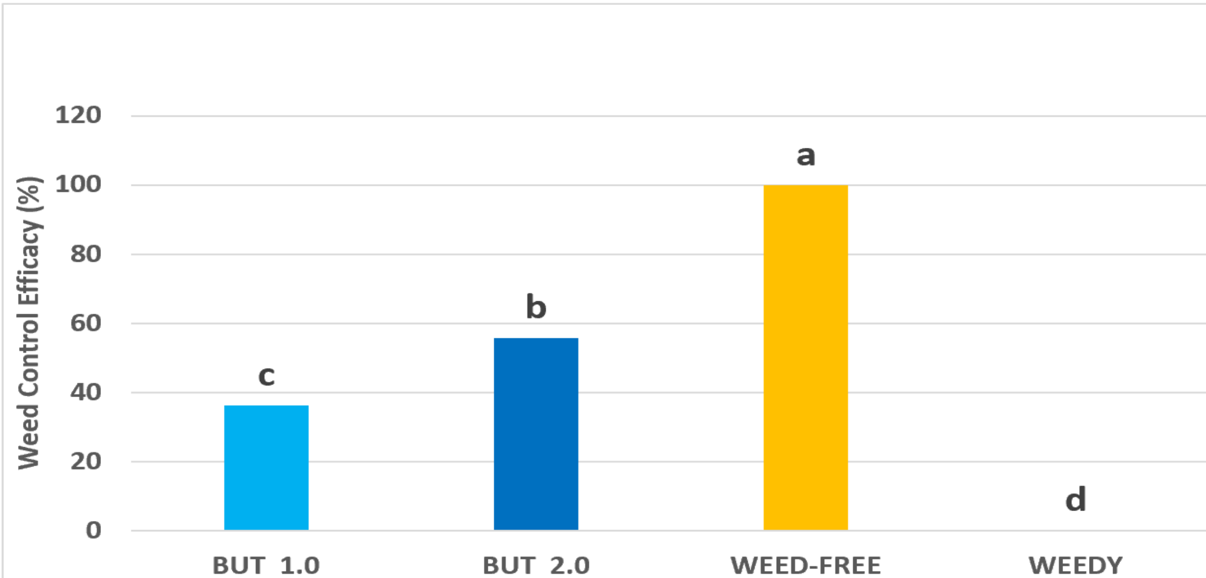
Efficacy of weed control

The WCE was affected by butachlor application of at lower and higher rates (Figure 2 A). Un-weeded control pots had no weed control efficacy while the hand-weeded pots had a total 100.0% weed control efficacy. Herbicide concentration significantly affected the WCE at ten WAT, the lower rate of butachlor had 36.3 % WCE while the higher concentration had 55.7 % WCE; therefore, increasing the herbicide concentration from 1.0 to 2.0 kg a.i./ha resulted in 53.4 % increase in WCE relative to the pots sprayed lower butachlor concentration.

Garden egg fruit yield

Garden egg fruit yield/plant ranged from 34.9g in weedy pots to 142.9 g/pot in hand-weeded pots (Figure 2 B). Among the parameters assessed, garden egg fruit yields were among the most sensitive variables; they significantly changed with a small change in the method of weed control; there was significant difference in the eggplant fruit yields. Fruit yield was highest in the hand-weeded pots and lowest in weedy pots. An increase in butachlor concentration from 1.0 to 2.0 kg a.i./ha increase fresh fruit yield from 82.5 to 120.7 g/pot, an increase of 46.3 % in fruit yield comparative to the lower butachlor concentration. Uncontrolled weed growth in eggplant resulted in a 75.6 % decrease in fruit yield.

A



B

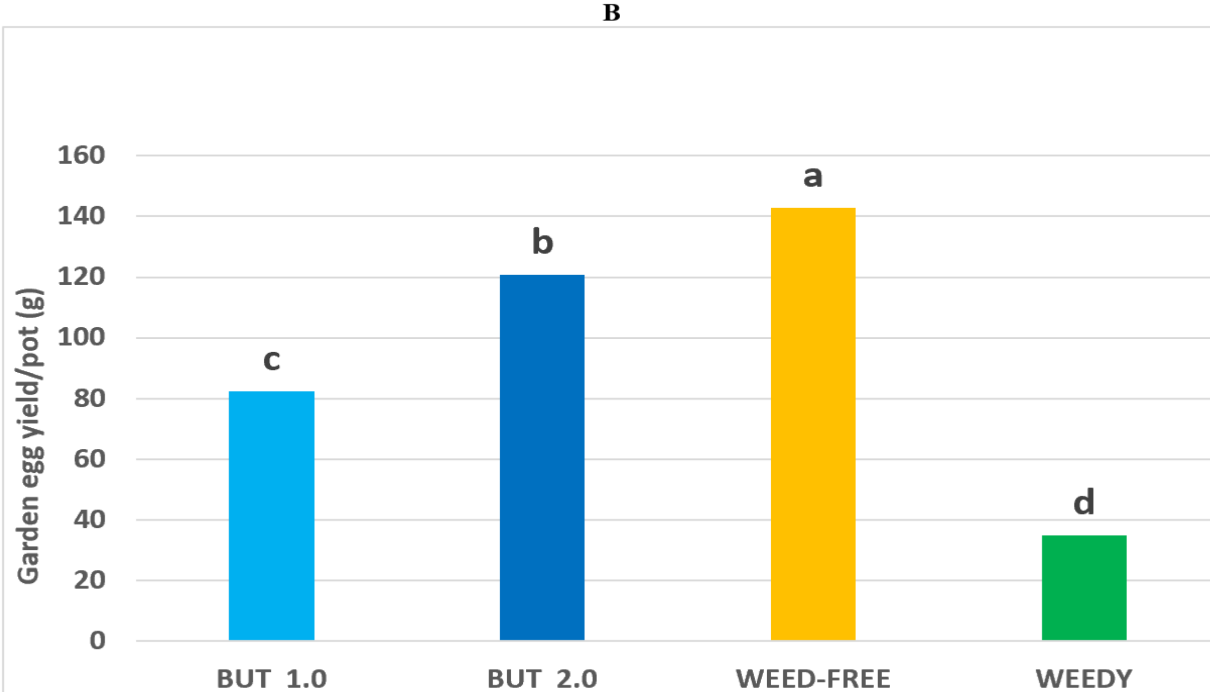


Figure 2.0: Effects of pre-emergence application of two levels of butachlor on weed control efficacy (A), and garden egg yield/per plant (B) at 10 WAT.

Note: Bars with similar letter(s) did not differ at 5% level of probability.

WAT= Weeks After Transplanting

4. Discussion

Plants in herbicide-treated pots had similar number of leaves from two to ten weeks after transplanting. The butachlor treatments were similar in the number of leaves/plant with the hand-weeded pots right from two to eight WAT; at 10 WAT that hand-weeded pots had a superior number of leaves/plant. Growth and yield parameters such as stem height, WCE, number of garden egg fruits/plant, and weed biomass at ten WAT were highly affected by herbicide concentration with the higher concentration resulting in significantly lower weed biomass.

Weedy pots were the highest in weed biomass, similarly, it was reported by (Obiazi, 2022[a]) that weedy control was with the highest weed biomass in a maize/cassava intercrop experiment.

Hand-weeded pots had highest fruit yield and weedy pots the lowest. The highest fruit yield of eggplant was from hand-weeded treatment, the similar result of the highest fresh root tuber yield was obtained from hoe-weeded plots by (Obiazi, 2022[a]). The hoe-weeded plots or the hand-weeded pots offered a situation where the least weed interference on the crops was permitted, hence they had the highest unhindered yield performance among the treatments.

5. Conclusion

Butachlor at low and high concentrations was tolerated by eggplant. Butachlor used at 2.0 kg a.i./ha produced eggplants with greater stem girth, number of fruits and yield/plant and had better WCE at 10 WAT; in addition, butachlor used at 2.0kg a.i./ha had similar performance in the number of fruits/plant with the weed-free treatment, even when weed-free had significantly greater fruit yield than butachlor used at 2,0 kg a.i./ha, it was able to produce fruit yields of 84.5% of weed-free control. Use of butachlor at 2,0kg a.i./ha is recommended in locations with similar ecology.

Declarations

Conflicts of interest/Competing interests **-**The author declares no conflict of interest.

Code Availability

Not applicable

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